



SEMICONDUCTOR DOMINANCE AND WESTERN DEPENDENCE: GEOPOLITICAL RISKS FROM TAIWAN AND CHINA

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ABSTRACT

This paper explores the geopolitical and economic risks posed to Western countries due to their dependence on semiconductors produced by Taiwan and China. It highlights the superiority of Taiwanese semiconductor manufacturing, led by TSMC, which significantly outpaces Western production in terms of technology and innovation. The research examines how a potential Chinese invasion of Taiwan could exacerbate the West's vulnerability by consolidating China's control over the global semiconductor supply chain. Additionally, the study discusses Western efforts, such as the CHIPS Act and EU Chips Act, aimed at reducing dependence on foreign semiconductors, while also analyzing the limitations of these initiatives. Through a detailed investigation of the semiconductor landscape, this paper underscores the critical role of innovation, supply chain security, and geopolitical stability in maintaining the West's economic and technological dominance in the face of rising Chinese influence.

KEYWORDS: Semiconductors, Taiwan, Dependence, Geopolitics, CHIPS Act, TSMC, Supply Chain

INTRODUCTION

The implications of a Chinese invasion of Taiwan are alarming to the West economically and politically. Since China and Taiwan are practically semiconductor duopolies, they control considerable portions of the global market share and are superior regarding chip architecture. For example, at Taiwan Semiconductor Manufacturing Company Limited's (TSMC) 2022 Technology Symposium Conference, it formally unveiled its N2 fabrication technology (Shilov, 2022), which operates on the 2nm process - the next MOSFET, or metal-oxide-semiconductor field-effect transistor. In this process, chips will yield superior performance over the older N3E node using 25-30% less power; this illustrates the quality standard attained by TSMC.

Conversely, Intel, the leading semiconductor manufacturer in the US, has only recently unveiled its Intel 4 fabrication technology, which operates on the comparatively inferior 7nm process (Smith, 2022). While it is important to note that the utilization of EUV lithography will benefit Intel in its pursuit of advanced manufacturing nodes, they are far away from the competition in the East. For these reasons, the West must address the political and economic risks they face due to rising industry control from China, Taiwan's semiconductor superiority, and inferior domestic fabrication plants.

METHODOLOGY

This study utilizes a qualitative secondary research methodology, relying on existing literature, government reports, and industry data to explore the geopolitical risks posed by semiconductor production in Taiwan and China. By reviewing academic articles, industry reports, and credible news sources, the research assesses the West's vulnerability due to its reliance on foreign semiconductor supply chains. The analysis includes

detailed discussions of Taiwan Semiconductor Manufacturing Company (TSMC) and Chinese semiconductor dominance, along with the potential consequences of a Chinese invasion of Taiwan. A secondary analysis of government initiatives, such as the CHIPS Act and EU Chips Act, is conducted to evaluate Western responses to this growing dependency. The qualitative approach is well-suited for this study, as it allows for an in-depth exploration of complex geopolitical issues through existing data. However, this method is limited by its reliance on secondary sources, which may not capture the latest industry developments.

1. Rising Industry Control from China

1.1 Domestically

China is steadily increasing its grasp over the semiconductor industry, and analysts project that it will be the largest producer by 2030 (Lewis, 2022). However, the rising disruptions from the West regarding sanctions and the fall in demand create a correction phase that means dominance in this sector will be harder to attain. According to the co-CEO of SMIC, the largest Chinese chipmaker, these disruptions will last well into the first half of 2023 (SMIC, 2022). The correction phase means that leading Chinese chipmakers such as SMIC will be subject to tighter profit margins, effectively slowing down expansion. The threat is still genuine, though, and China's influence over the semiconductor industry has and will continue to grow. In 2019, China produced 35% of the world's semiconductors. In addition, China imported substantial quantities of semiconductors - totaling \$350 billion in 2020 (Borak, 2021).

While China's control over production has risen, its pursuit of self-sufficiency has been frustrated in recent years. Semiconductor equipment manufacturers are primarily corporations in the West (semiconductor manufacturing),

which means that in this regard, the West holds a confident grasp on China in their manufacturing of semiconductors. Furthermore, cognizant of the continuing sanctions against the South Eastern giant, it is evident that efforts to become the most extensive semiconductor producer are at risk. However, in response to those mentioned above, there has been a myriad of government incentives and subsidies, which will further stimulate semiconductor manufacturing in China and edge it closer and closer to surpassing the competition concerning production (Lewis, 2022).

This threatens the West, given their long-term dependence on China for semiconductors. Kamala Raman, vice president at the Gartner Supply Chain Practice, recommends three measures for the United States to reduce long-term dependence. First, through incorporating diversification strategies through regional sourcing or a nearshoring approach, and next, by reducing dependence by moving small-demand quantities away from China and into other markets. Last, establishing practical courses of action that will constitute clear trigger points for action (Rowell, 2022). These measures will minimize the risk of dependency; however, they fail to consider China's retaliation in these events, which includes the invasion of other markets such as Taiwan. With the expansion impeded, the pursuit of self-sufficiency frustrated, and incessant pressure from the West, the question arises: what is China to do?

1.2 An invasion of Taiwan—how this would increase China's control over the industry

In 1949, Taiwan gained its independence from China, but since then, Beijing has asserted on numerous occasions that only one China existed and that Taiwan was part of it (Maizland, 2022). While tensions have not ceased to grow since the independence of Taiwan, now more than ever, China finds it in its best interests to invade the island nation. Taiwan's TSMC is the most valuable semiconductor manufacturer in the world, accounting for more than 60% of the annual revenue in this sector, significantly more than any Western entity (Maizland, 2022).

Recognizing the significance of semiconductors, from applications in refrigerators and vehicles to applications in military planes, it is clear why China sees value in Taiwan. After all, in invading Taiwan, they would be even more dominant in political talks since they would hold such a large portion of this valuable product. China could also manipulate prices, given its grasp over the world supply. The United States, along with other countries in the West, is cognizant of the threat this poses to their security, both economically and politically. Accordingly, they have responded in three ways. President Joe Biden proclaimed that the US would defend Taiwan in the event of an invasion (Brunnstrom, 2022). The United States passed the CHIPS and Science Act, which provides approximately \$280 billion in funding to semiconductor researchers and manufacturers (Ravi, 2022). Lastly, the EU Chips Act provides approximately \$40 billion to "prevent, prepare, anticipate, and swiftly respond to any future supply chain disruptions" (European Commission, 2022).

However, there are multiple issues with these measures. For starters, the proclamation issued by Joe Biden is ambiguous. While it may imply several things, it is evident that a war using sanctions would accomplish little in defeating China, which is known to be very economically robust. A war using military intervention would put too many lives at risk and likely result in a stalemate (regardless of the superior US military, this war would be on the offense as opposed to the defense, which is less practical). Moreover, the acts mentioned above will likely take more than a decade to come into actual effect. This will give ample time for China to invade Taiwan and develop even more sophisticated architectures for their semiconductors. Unfortunately, the fabrication units described in the EU Chips Act are inferior in complexity to those of Taiwan or China (which have achieved process nodes below 5nm, a feat European fabrication units lag in matching).

This is without even considering the retaliation by China, which has vowed to become less and less dependent on Western semiconductor equipment as part of their Made in China 2025 Act which aims to produce 70% of the country's chip consumption domestically by 2025 (EU Chips Act, 2022). The West will be under severe political and economic risk if they fail to mitigate the risk of dependency. Therefore, to protect themselves, they should explore the solutions mentioned earlier proposed by Kamala Raman and work closely with leading experts in the Taiwanese semiconductor industry to develop competing products that will not be at a disadvantage compared to other manufacturers.

2. Taiwanese Semiconductor Superiority

2.1 Stability, Innovation, & Intact Finances

At the forefront of the global semiconductor manufacturers are TSMC and, more broadly, Taiwan. They have consistently reported better-than-expected earnings, even amidst the shortage of materials and labor instigated by the pandemic. The company reported that quarterly revenue rose almost 47% compared to a year ago—to a staggering \$19.2 billion (Taiwan Chipmaker TSMC, 2022). This implies their strong financial status that will continue to grow amidst sanctions on China. After all, like other Taiwanese companies, they heavily rely on investment from Beijing. According to a top executive, the sanctions have proven to be "limited and manageable." (TSMC, 2022).

Considering their high revenues, TSMC allocates \$36 billion on capital equipment. The funds are well-used, and many leading researchers work for the Taiwanese company. For this reason, they have created such advanced technology and are at the forefront of semiconductor innovation globally. Their nodes are among the most complex, and their supply chain has been able to tackle the shortage and grow exponentially (TSMC, 2022). Taiwan is superior to other countries in this regard, which is why the West has reached out to them to alleviate shortages. Moreover, their focus solely on manufacturing for the upcoming years means that the country has become a global leader.

2.2 Why This is a Threat to the Western Economic and Political Well-Being

However, it has also meant that they have been put in the spotlight by foreign entities such as China. Amidst this conflict between the two, which will, given China's reassurances to its people, most likely result in an invasion, a substantial amount of the global chip supply is under threat. This means that countries such as Germany and the United States, as well as other Western countries, are at risk of losing a valuable partner in Taiwan, but more importantly, are at risk of losing the complex chip manufacturing that companies such as TSMC can provide.

Western entities such as the United States depend heavily on their military in international peace talks; they can leverage their formidable armed forces to negotiate practical treaties. However, the lack of solid semiconductor architecture will challenge their armed forces. Aircraft such as the F-35 and F-22 depend, to a certain degree, on advanced semiconductors for computerized instruments (Hubinger, 2019). The prospect of losing Taiwan poses a fundamental long-term threat to national security for countries such as the United States.

3. Western Inferiority

Regardless of the substantial investment towards semiconductor architecture and research, the West faces a straightforward reality: they lack natural resources or the attractive price of natural resources found in China and Africa. Moreover, while it is evident that production is a problem in manufacturing semiconductors, supply, or the lack thereof, may pose an even more significant threat to the West. Currently, the United States is building three semiconductor plants—one in Texas, one in Arizona, and one in Michigan. However, they lack the expertise of more experienced "players" in Southeast Asia.

Because of the support TSMC has given the US in constructing these plants, it is still reasonable to assume that they are less complex than their Taiwanese and Chinese counterparts. However, even under circumstances where these fabrication plants were as complex as their Asian counterparts, the lack of experience in the field would mean that operations at these plants would likely be obsolete after a decade.

In other words, subsidies are nothing new to the West; there has been a massive influx of them in recent years. However, it has yet to divert its market share away from Taiwan and China. The simple answer behind this is innovation. If the West can produce semiconductors as complex as other offerings, they will be able to compete. However, this is different from what has happened in recent years, and will only improve via an extensive re-evaluation of the semiconductor industry.

CONCLUSION

The West should entertain dialogue with leading semiconductor manufacturers, such as TSMC, and discuss the logistics of moving operations to another country. The West is to finance this move and invest in research and development of advanced technologies that will place it and TSMC at the forefront of endeavor in this competitive market. While moving operations and constructing new fabrication facilities may take time, it is a worthwhile investment to mitigate the economic and political

risk of dependence on China should a conflict arise between them and their neighbor.

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